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(54) **PATTERNED MAGNETIC RECORDING MEDIA WITH DISCRETE MAGNETIC REGIONS SEPARATED BY REGIONS OF ANTIFERROMAGNETICALLY COUPLED FILMS**

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(58) **Field of Search** **428/212, 213, 428/694 TM, 65.3, 65.5, 65.7, 900, 694 TS**

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,408,377 A	4/1995	Gurney et al.	360/113
5,465,185 A	11/1995	Heim et al.	360/113
5,587,223 A	12/1996	White	428/195
5,768,075 A	6/1998	Bar-Gadha	360/135
5,820,769 A	10/1998	Chou	216/22
6,280,813 B1 *	8/2001	Carey et al.	428/65.3

OTHER PUBLICATIONS

Abarra et al., "Longitudinal Magnetic Recording Media with Thermal Stabilization", Program of the 2000 IEEE International Magnetism Conference, Apr. 9-13, 2000, p. AA-06.*

C. Chappert, et al., "Planar Patterned Magnetic Media Obtained by Ion Irradiation," *www.sciencemag.org—Science*, vol. 280, Jun. 19, 1998, pp. 1919-1922.

B. D. Terris, et al., "Ion-Beam Patterning of Magnetic Films Using Stencil Masks," *Applied Physics Letters*, vol. 75, No. 3, Jul. 19, 1999, pp. 403-405.

* cited by examiner

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ABSTRACT

A magnetic recording disk is patterned into discrete magnetic and nonmagnetic regions with the magnetic regions serving as the magnetic recording data bits. The magnetic recording layer comprises two ferromagnetic films separated by a nonferromagnetic spacer film. The spacer film material composition and thickness is selected such that the first and second ferromagnetic films are antiferromagnetically coupled across the spacer film. After this magnetic recording layer has been formed on the disk substrate, ions are irradiated onto it through a patterned mask. The ions disrupt the spacer film and thereby destroy the antiferromagnetic coupling between the two ferromagnetic films. As a result, in the regions of the magnetic recording layer that are ion-irradiated the first and second ferromagnetic films are essentially ferromagnetically coupled so that the magnetic moments from the ferromagnetic films are parallel and produce a magnetic moment that is essentially the sum of the moments from the two films. In the non-irradiated regions of the magnetic recording layer, the first and second ferromagnetic films remain antiferromagnetically coupled so that their magnetic moments are oriented antiparallel. The composition and thicknesses of the first and second ferromagnetic films are selected such that essentially no magnetic field is detectable at a predetermined distance above the magnetic recording layer corresponding to the height that the magnetic recording head would be located.

14 Claims, 4 Drawing Sheets

